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ABSTRACT

These materials were developed for use in workshops with teachers. The document suggests a four-stage framework which students can apply to problems: (1) get to know the problem; (2) choose what to do; (3) do it; and (4) look back. Suggestions are included for each of the four stages of the probem solving process. Other specific techniques for improving comprehension of word problems are Cloze exercises and identifying differences between similarly worded problems. Nine other specific techniques are briefly discussed. The document includes exercises for teachers, sample work sheets for students and a bibliography on problem solving. (PK)

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Improving Students' Understanding of Math Word Problems

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SE 049 431

IMPROVING STUDENTS' COMPREHENSION OF WORD PROBLEMS

Teach students a general framework they can apply to problems, such as: (from LeBlanc, 1977, in Worth)

1. Get to know the problem.
2. Choose what to do.
3. Do it.
4. Look back.

OR:

1. Think.
2. Plan.
3. Solve.
4. Look back.

Suggestions for Each Stage of the Problem Solving Process

1. Get to know the problem.

   A. "Are there any words you don't know?"
   "What does _____ mean? What is a _____?"
   "Are there any terms that have a specialized math meaning as well as more common, everyday meanings?" (area, prime, volume, root, etc)

   B. Ask questions that will focus students' attention on the information given in the problem, any conditions, and on the question being asked.

   Example problem: A shopkeeper sold 485 bottles of cola in one day. The cola is packaged in cartons holding 6 bottles. How many cartons of cola were sold?

   Example questions, focusing on literal information:
   "John, how many bottles were sold?"
   "Nina, how are the bottles packaged?"
   "Felix, how many bottles in a carton?"
   "What does a carton look like?"
   "Does everyone always buy a full carton? Does that make any difference to our problem?"
   "If one carton were sold, how many bottles would be sold?"
   (Example from LeBlanc, 1977).

   This questioning step insures that students are aware of the specific information that is already available in the problem. This review of literal information given in a problem gives the student the sensation of comprehending the text of the problem, and helps students improve their ability to extract information from word problems. (Stiff, 1986).

   C. "What are you trying to find out in this problem?"
   "What does the problem ask for? Can you tell it in your own words?"

   D. "Retell the problem in your own words. Tell what you know and what you need to find."

   E. "Can you 'see' the situation?"
   "Can you draw a picture of the problem, or act it out?"

1. Get to know the problem (continued)

F. "Do you have all the data you need to solve the problem?"
"Have you discovered all of the 'given'?"
"What data in the problem do you think you need to find the answer?"
"Do you have extra, unnecessary data?"

G. "How will your answer be labeled?"
"Are there different units of measure used in the problem than are asked for in the question?"

H. "What is a resonable, sensible 'guesstimate' of the answer?"
This is a crucial question, because it focuses on the meaning of the problem and prompts the student to think of a common sense answer before computing.

2. Choose what to do.

This is the planning stage during which students consider strategies for solving the problem.

Example problem: There are 8 people at a party. If each person shakes hands with the other guests, how many handshakes will there be?

Choose what to do: Strategies:

a) "Let's act it out by using eight kids. Come on, let's get in a circle." (Experiment).
b) "I'm going to draw it out by putting eight dots in a circle and using lines to show handshakes." (Diagram)
c) "I'm going to give the people names and make a list of the people each shakes hands with." (Organized list)
d) "I wonder if there is a pattern...if there are two people, there is one handshake, but if there are three people, there are three handshakes..." (Using a table to find a pattern)
e) "Well, if each person shakes hands with the others, then eight people shake hands with seven others, so there are eight times seven handshakes..." (Deduction)
(Example from LeBlanc, 1977)

As a teacher, you must plan specific instruction to develop these strategy skills. The following are some strategies your students should have to choose from: (Worth, 1982)

*draw a picture/diagram
*solve a simpler problem
*make an organized list
*make a graph
*do an experiment
*guess and check
*make a table
*use logical reasoning
*work backward
*find a pattern

The teacher needs to identify and label the strategies students suggest so that they will learn to articulate the strategies. Problems that lend themselves to solution by using a variety of strategies are of greatest instructional benefit, since one goal of problem solving instruction is to develop flexibility in considering alternate solution strategies.

3. Do it.

Use computational skills to carry out the plan.
Allow the use of calculators so that lack of computational skill does not get in the way of the ability to solve problems.

4. Look back.

A. Have students explain the strategy used to solve the problem and WHY this strategy was appropriate. Questions such as the following ask students to look at their own thinking and describe it. Such introspection benefits the student as well as the other students who hear how someone else thinks about the problem. (LeBlanc, 1977). Having the student articulate the reasoning process further clarifies the students' understanding of the process.

"Show us at the board how you worked it out."
"Describe your solution to the rest of us."
"What were you thinking when you planned your solution?"
"Does your answer fit the question in the problem?"
"Is your answer reasonable?" (accuracy)
"What other strategies could also have been used to solve this problem?" (appropriate processes)

B. Extending the problem by changing one or more of the conditions gives students further problem solving practice:

"Suppose _____, then what might we do?"
"What if _____? Could we use the same strategy?"

C. Have students check their answer by writing a complete answer to the question posed in the word problem.

OTHER SPECIFIC TECHNIQUES FOR IMPROVING COMPREHENSION OF WORD PROBLEMS

1. CLOZE EXERCISES (Denmark, 1983).

Use word completion tasks which require students to follow the meaning of the passage as they determine the words or numbers that could complete each statement.

It is important to point out that sometimes several words could be used to complete a given blank. A list of words which can be used to complete the sentences can be provided, since some students will find this exercise very difficult initially.

Example:

2/3	360	60½	6

A baseball diamond is a square with a perimeter of _____ feet. The distance from the pitcher's mound to home plate is _____ inches more than _____ of the distance between the bases. When the pitcher's foot is on the mound, how many feet is the pitcher from home plate?
(Example from Arithmetic Teacher "Problem Solving Tips for Teachers")

1. CLOZE EXERCISES (continued)

Example:

2	6	5	7
11	30		

Mrs. Green bought _____ T-shirts at $_____ each.
She also bought a pair of shorts for $_____.
The shorts were $_____ more than each T-shirt.
Mrs. Green gave the clerk $_____. How much
change did Mrs. Green get? _____

Example: A store is having an end-of-year sale. All items are marked down 25 percent. What is the sale price of a pair of jeans that regularly sells for $20 a pair?
This problem is asking you to find the _____ of the jeans after they have been _____ by an amount that is _____ percent of the regular price. One method of solving the problem is to first find out how much you will _____ by buying the jeans on sale. This amount can be found by _____ $20 by _____. The next step is to _____ the amount you save from _____.
The result is the _____ price of the jeans.

In this example (from Denmark, 1983), the format states the problem, restates what is to be found, and gives a method for solving it along with a statement that relates the answer to the original question.

2. IDENTIFYING DIFFERENCES BETWEEN SIMILARLY WORDED PROBLEMS.

Have students become sensitive to the language of word problems by having them read a pair of problems and then decide whether or not the problems are really the same, without computing the answer. If the problems are similar, the differences should occur in the sentence structure, the vocabulary, the method of presenting the data, or the statement of the question.

By discussing the equivalency of such terms as "25 percent markdown" and "reduced one-fourth," students focus attention on key words that make a difference in the correct interpretation of a problem.

Have students solve the problems to verify the decisions. (Denmark, 1983).

Example Set A: Are the problems in each pair the same?

1. A coat usually sells for $40, but it is marked down 25 percent. How much do you save by buying the coat on sale?
2. A store is reducing everything by one-fourth. What is the sale price of a coat that usually costs $40?

Example Set B: Are the problems in each pair the same?

1. A room is 10 meters long and 8 meters wide. How much decorative tape is needed to make a band around the ceiling?
2. How many meters of decorative tape are needed to make a border around the ceiling of a room that measures 10 meters by 8 meters?

(Examples from Denmark, 1983)

OTHER SPECIFIC TECHNIQUES FOR IMPROVING COMPREHENSION OF WORD PROBLEMS (continued)

3. Have students provide appropriate questions for word problems you present.

   Example: Make up a question for this word problem.
   Two rafts are on a trip going down the river.
   There are 24 people in the first raft.
   There are 19 people in the second raft.
   _____?

4. Have students practice writing equations that fit the problem situation.

   Example: One morning 9 cars went to Hyde Park.
   Each car had 3 people inside.
   How many people went to the park? 27 (Give the answer).

5. Have students practice identifying extraneous information.

   Example: There is a meeting at school to talk about the trip to Sacremento. It takes Donald 35 minutes to walk to school. It takes him 15 minutes if he rides his bike. He left his house at 8:15a.m. and walked. What time did he get to school?
   (Above three examples from Silver Burdett 4th grade text)

6. Have students make up a story to fit data you present: 13 - 7 = ___
   By having students make up stories to fit specific number sentences, teachers can help learners identify the correct operation for a story problem. (LeBlanc, 1982).

7. Have students make up their own word problems. In doing so, they become better at identifying parts of problems, better at setting them up, and better at solving them because they understand them more clearly.

8. Let students work in pairs or small groups to solve problems. The problem solving process may take longer, but students learn more as they explain their strategy ideas to others and critique others' strategies.

8. Present problems orally from time to time to increase listening comprehension.

9. Structure problem-solving activities from easy to more difficult. Students need to practice strategies at an easy-to-understand level of difficulty in order to internalize the strategy and move on to a more difficult level of problems. Seek out textbooks of lower grades for simpified strategy explanations and simpler practice problems.

10. When assigning word problems, ask for more than answers. Guide students orally through problems, then ask for written responses to the following items:
    1. What is being asked for?
    2. What information is given?
    3. How will the information be used to solve the problem?
    4. Draw a picture/diagram of the problem (if possible).
    5. Solve the problem.
    6. Write a complete answer statement to the question.

Reasons why students make mistakes as they solve problems:

Factors that characterize good problem solvers:

Reading activities that improve problem-solving achievement?

What can teachers do to help children learn to solve problems?

What has recent research told us about problem solving?

HELPING STUDENTS READ AND UNDERSTAND WORD PROBLEMS

*Have students first read problems silently then reread them aloud.

*Have students read silently as you read the problem aloud.

*Have students become aware that math requires slow, careful reading, not the same type or rate of reading that characterizes reading stories.

*Have students read the problem with expression.

*Have students read the problem to another student, who may ask questions

*Have the students read the problem for specific information, for answers to questions we pose about the literal information given.

*Have students draw a picture of the problem as you read it aloud.

*Remove the numbers from the problem and discuss what is being asked for.

*Have students replace larger numbers with smaller numbers.

*HAVE STUDENTS TELL THE PROBLEM IN THEIR OWN WORDS.

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PROBLEM SOLVING ON PARADE

NOW, use your lists to write a story problem:

BLAST OFF!

In your math textbook, find twelve key math terms that are used often and that are important to your understanding of math word problems.

Write these "key" words in the shuttle and write their meanings on the back of this page.

Keeping these "key" words and their meanings in mind will help you "blast off" to a better understanding of math word problems.